Increase of Tsunami risk on coastal areas in Shizuoka Prefecture associated with decadal urban area expansion and importance of public understanding of geomorphology.

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A Nankai trough earthquake (M8 or more)has occurred once every 90 to 150 years and the latest one occurred 70 years ago. The next earthquake is predicted to occur with about 70 % probability in the next 30 years (Shizuoka Prefecture, 2013). Coastal area in Shizuoka Prefecture has been developed rapidly as a part of the industrial area so-called Pacific belt zone. This study focuses on the analysis of decadal changes of DIDs distribution and geomorphology on three coastal lowlands in Shizuoka Prefecture, Hamamatsu, Shimizu , and Ukishimagahara lowlands, and discuss change of tsunami disaster risk.
The analysis was conducted by using GIS among following data. The results of land classification by aerial photo interpretation and elevation obtained from DEMs represent geomorphology. DIDs of 4 periods from 1960 to 2005 represent urban expansion. School locations and their established periods represent exposure with high vulnerability. Ansei-tokai earthquake tsunami inundation zone (Shizuoka Prefecture, 2001) and Nankai trough earthquake estimations of tsunami inundation zone (Shizuoka Prefecture, 2013) represent hazard.
DID’ s expansion in lowland is considered to be the combination of the following two tendencies. (A) Big community on the barriers became DID at first, then DIDs expanded on barriers. After DIDs filled up barriers, DIDs expanded to other geomorphology such as back marsh, fan, and sand mouth. (B)By impact of a city out of the plain, DIDs expanded from the edge part of the plain which is close to the city. Type A is observed in Shimizu, type B is observed in Ukishimagahara, both type A and B are observed in Hamamatsu.
As results of comparing among Ansei-tokai earthquake tsunami, Nankai trough earthquake tsunami, and DIDs in 1960, 1975, 1990, 2005 in each study area, inundated DID area has increased as year passed, which means tsunami disaster risk has increased in each area. In Shimizu, tsunami risk has been high in 1960 since sea side lowland has already been developed by 1960. Development after 1960 has been around hill with high elevation, risk gain has comparatively been low. In Hamamatsu, inundated DID area have been increasing from 1960 to 2005, which means tsunami risk has also been increasing. In Ukishimagahara, development started later than other lowlands and DIDs has expanded without considering geomorphology. It leads possibly to gain tsunami risk in the future. But it is not clear that tsunami risk in Ukishimagahara will be higher than another lowland since inundation area is the smallest of all.
Comparing among Ansei-tokai tsunami, Nankai trough earthquake tsunami, and school locations showed the following results. In Hamamatsu, 5 schools are located in Ansei-tokai tsunami inundation zone, 9 schools are located in Nankai tsunami. In shimizu, 3 schools are located in Ansei-tokai tsunami inundation zone, 5 schools are located in Nankai tsunami inundation zone. In particular, every inundated schools in Shimizu are elementary school, which means tsunami risk in Shimizu is particularly high.
Barriers are a few to ten and several meters higher than back marsh in each area. Considering that Nankai trough tsunami in each area is estimated a few to ten and several meters and that structures were especially vulnerable when the flow depth exceeded 2 m (Hayashi et al., 2013 etc), the fact that barriers are a few to ten and several meters higher than back marsh is important to reduce tsunami damage.

Ground condition on barrier excepting for the margin is also better than back marsh. Since barriers developed with parallel or arcuate form along a coastal line, it is helpful to image its distribution. In coastal lowland where high ground such as hills are distant, public understanding of geomorphology especially barriers and redevelopment of barriers such as moving vulnerable facilities including elementary schools which are located in inundation zone to barriers are important to do effective tsunami disaster prevention.

(reference)
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